The Public Interest Benefits of a Market-Based Solution for the C-Band

AVOIDING ECONOMIC AND INFORMATIONAL MARKET FAILURES, PROTECTING INCUMBENTS, AND ACCELERATING 5G DEPLOYMENT

PREPARED FOR

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Executive Summary

This paper discusses how a Coasian market-based mechanism, such as the consortium proposed by the C-Band Alliance, can overcome market failures that lead to significant holdout problems, solve issues of informational complexity that lead to regulatory failures, maximize the amount of spectrum available in the marketplace while protecting incumbent operations, and ensure that the spectrum is put to its highest valued use. This approach, which is applicable in incentivizing incumbents to discover value creating spectrum repurposing well beyond the C-Band, fits in well with the FCC's light-touch approach to regulating the mobile market. This paper also discusses why the C-Band Alliance's revenue sharing mechanism, that is, that excess revenue should be returned to its members in proportion to their contribution to the creation of value, is in line with well-accepted economic tenets.

I. Introduction

A. Overview

"The market, not the government, is best positioned to drive innovation and investment in the wireless field." – FCC Chairman Ajit Pai (April 12, 2019)[1]

This paper updates my prior analysis, which I filed in this proceeding in October 2018.[2] In that paper, I found that the C-Band Alliance's (CBA's) market-based proposal to repurpose the C-Band for 5G would maximize social utility within the shortest possible timeframe while preserving

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1 Margaret Harding McGill, "Trump rejects government intervention in 5G wireless networks," *Politico*, April 12, 2019, Accessed July 12, 2019, https://www.politico.com/story/2019/04/12/trump-government-intervention-5g-wireless-networks-1352763.

2 FCC, "Expanding Flexible Use of the 3.7-4.2 GHz Band et al.," Order and Notice of Proposed Rulemaking," GN Docket No. 18-122 et al., FCC No. 18-91, Adopted July 12, 2018. ("C-Band Order and NPRM").

incumbent uses upon which hundreds of millions of Americans rely.[3] I estimated that the value created by repurposing the C-Band spectrum will likely be measured in the many billions of dollars.[4] This paper revisits the conclusions and analysis of my October 2018 study in light of intervening developments—in particular, the CBA's updated proposal and Eutelsat's withdrawal from the CBA. The updated proposals from the CBA build on its initial proposals and further clarify how the CBA approach can solve market and regulatory failures and leverage market mechanisms to efficiently put C-Band spectrum to higher valued uses.

In this paper, I discuss how the updated CBA proposal is an application of a Coasian market-based mechanism where well-defined property rights and a consortium structure that minimizes transactions costs creates the incentives for market participants to achieve regulators' goals. It achieves this through overcoming market failures due to holdout problems, solving issues of informational complexity that lead to regulatory failures, putting in place incentives to transition the efficient amount of spectrum while protecting incumbent operations, and ensuring that the spectrum is put to its highest valued use. This approach, which is applicable in incentivizing incumbents to discover value creating spectrum repurposing well beyond the C-Band, fits in well with the FCC's light-touch approach to regulating the mobile market.

In what follows, after a brief section on the updated CBA proposal, I discuss the public interest benefits created by this proposal. Then I put the CBA proposal in the larger context of how such a proposal can create incentives for incumbent spectrum holders to engage in efficiency enhancing repurposing of their spectrum that applies well beyond the C-Band.

B. Updated CBA Proposal

Since my initial analysis in October of 2018, the FCC's proceeding to repurpose C-Band spectrum for terrestrial use to support 5G deployments has seen active engagement by the CBA itself and many other stakeholders, both on the importance of this band for 5G and the need to bring this

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[3] Coleman Bazelon, "Maximizing the Value of the C-Band," Comments on the FCC's NPRM to Transition C-Band Spectrum to Terrestrial Uses, pp. 14, October 29, 2018, https://ecfsapi.fcc.gov/file/102980223165/Intel_Intelsat_SES_Joint_NPRM_Comments%20Final%2010-29.pdf, ("Maximizing the Value of the C-Band").

[4] Coleman Bazelon, "Maximizing the Value of the C-Band," p. 23.

spectrum to market in an efficient and timely manner.[5] There have been filings from both proponents and opponents of the CBA proposal. Recently, Verizon has reiterated its support for the CBA proposal, noting that the most efficient way to repurpose the C-Band spectrum would be through a "private market auction and repacking of the band."[6] In contrast, ACA Connects has maintained its opposition to the plan.[7] For its part, the CBA has explored technology that will allow it to repurpose 300 megahertz of spectrum without disrupting current operations and has made a commitment to protect incumbents in this band, as well as to protect consumers who receive service from this band.[8] We explain these elements of the CBA's approach in greater detail below.

With this additional year to engage with stakeholders, the CBA has revised and improved its initial proposal. The initial proposal from Intelsat and SES began with an offer to repurpose 150 megahertz of spectrum (100 megahertz of flexible use spectrum and a 50 megahertz guard band), although even that proposal had acknowledged that if "the terrestrial demand for mid-band spectrum is as robust as claimed, their market-based approach could result in additional spectrum being cleared in the future—but in a manner and timeframe that protects Intelsat's and SES's

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5 Bret Swanson, "Filling the Mid-Band Spectrum Gap to Sustain 5G Momentum," AEIdeas, American Enterprise Institute, April 24, 2019, accessed October 11, 2019, https://www.aei.org/technology-and-innovation/telecommunications/filling-the-mid-band-spectrum-gap-to-sustain-5g-momentum/.

6 Verizon *Ex Parte* on the "C-Band Order and NPRM," p. 2, GN Docket No. 18-122, September 26, 2019, https://ecfsapi.fcc.gov/file/10926608609101/Verizon%2009.24.19%20Ex%20Parte%20Meeting.pdf.

7 ACA Connects *Ex Parte* on the "C-Band Order and NPRM," GN Docket No. 18-122, September 26, 2019, https://ecfsapi.fcc.gov/file/1092589840166/190925%20ACA%20Connects%20Ex%20Parte%20re%205G%20Plus%20Plan%20Supplement.pdf.

8 Ex Parte Submission C-Band Alliance, GN Docket No. 18-122, p. 1, Oct. 28, 2019, https://ecfsapi.fcc.gov/file/102834592770/CBA%20-%20Ex%20Parte%20Submission%20re%20300%20MHz.pdf, ("CBA 300 MHz Ex Parte"); *See also,* Comments of the C-Band Alliance on the "C-Band Order and NPRM," p. 9, GN Docket No. 17-183, 18-122, October 29, 2018, https://ecfsapi.fcc.gov/file/1029067703990/C-Band%20Alliance%20NPRM%20Comments%2010.29.2018.pdf ("CBA Oct. 29, 2018 Comments on C-Band Order and NPRM"); *See also*, FCC, "C-Band Order and NPRM," ¶27-29 C-Band Alliance, Customer Commitment Ex Parte, GN Docket No. 18-122, filed April 3, 2019, https://ecfsapi.fcc.gov/file/10403446622844/CBA%20-%20Customer%20Commitment%20Ex%20Parte%20-%204-3-19.pdf,("Customer Commitment Ex Parte").

customers and their businesses."[9] Subsequently, given market demand and input from many constituents, the CBA increased the amount offered to 200 megahertz (180 megahertz usable and a 20 megahertz guard band), and at the same time ensured that incumbents and its customers would be protected.[10] Now after further market and customer input, and incorporating more advanced compression technology, the CBA is able repurpose 300 megahertz of spectrum for flexible use (280 megahertz for flexible use and a 20 megahertz guard band).[11] Thus, the CBA mechanism allows for a fast and efficient repurposing of spectrum – much more and quicker than would be achieved in an administrative process.

In terms of customer commitments, the CBA has earmarked "120% of the estimated spectrum clearing costs" and will be using it to pay for the cost of clearing the spectrum, the cost associated with repacking satellite services and expenses incurred by customers and end-users.[12] These reimbursed costs will include technical support, antenna and filter installation programs and other miscellaneous costs associated with the transition.[13] The CBA has also been working to compile a list of all C-Band antennas in the U.S. to plan for a smoother transition of the spectrum and provide technical solutions to ease the transition.[14] In addition, to clear the 300 megahertz of spectrum, there are plans to launch new satellites and the CBA is working with all involved parties to adopt state-of-the-art technology, such as high-efficiency video encoding, needed to clear more spectrum.[15] Recently, the CBA has committed that it will be "fully responsible for all costs

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9 Intelsat, SES, and Intel Notice of Ex Parte Presentation, on the "C-Band Order and NPRM," GN Docket Nos. 17-183, 18-122, April 20, 2018, https://ecfsapi.fcc.gov/file/1042067576471/as-filed%204-20-18%20ex%20parte%20notice.pdf.

10 Ex Parte Letter of the C-Band Alliance, GN Docket Nos. 17-183 and 18-122, Oct. 23, 2018, https://ecfsapi.fcc.gov/file/102344940213/CBA%20-%2010.22.18%20-%20Ex%20Parte%20Notice.pdf.

11 C-Band Alliance, "CBA 300 MHz Ex Parte," Oct. 28, 2019.

12 C Band Alliance, "Customer Commitment Ex Parte," p. 8, April 3, 2019.

13 C Band Alliance, "Customer Commitment Ex Parte," Attachment A, April 3, 2019.

14 C Band Alliance, "C-Band Antennas in the Continental U.S.," August 20, 2018, accessed October 14, 2019. https://c-bandalliance.com/c-band-antennas-continental-u-s/. *See also,* Comments of the C-Band Alliance on the "C-Band Order and NPRM," GN Docket Nos. 17-183, 18-122, August 7, 2019, https://ecfsapi.fcc.gov/file/108071378423084/CBA%20-%20Comments%20to%20Other%20Proposals%20PN.pdf.

15 C Band Alliance, "CBA 300 MHz Ex Parte," Oct. 28, 2019; *See also*, C-Band Alliance Technical Ex Parte, "Tranche 1 Satellite Earth Station Analysis," GN Docket No. 18-122, Oct. 31, 2019, https://ecfsapi.fcc.gov/file/103150816652/Technical%20Ex%20Parte%20re%20Filter%20Analysis.pdf, ("CBA Technical Ex Parte Oct. 31, 2019").

necessary to implement the reallocation of 300 MHz of spectrum," including costs such as technology upgrades, launching and replacing satellites and so on.[16] Additionally, the CBA's updated transition plan lays out a detailed plan and timeline for clearing this spectrum.[17] This process, while challenging, will be the least disruptive path to getting more spectrum on the market while minimizing transaction costs. The CBA working with key customers to create additional clearing illustrates the Coasian proposition of using a market-based bargaining process to find the solution that maximizes value creation and public benefits from repurposing C-Band spectrum.

Overall, the developments in the increased amount of spectrum, the reduced size of the guard band, and customer commitments and technical parameters reflect input from would-be buyers, customers and earth station operators and demonstrate how market forces are able to take into account new information and craft a market-based solution.[18]

II. Public Interest Benefits of the CBA's Updated Proposal which Continues to Solve Market and Regulatory Failures

As explained in detail in my October 2018 analysis, both market and regulatory failures in the C-Band prevent these valuable frequencies from being put to higher value uses.[19] The central market failure is the overlapping nature of the rights to use the band, which prevents market forces (private market negotiations) from finding an efficient solution to put the C-Band spectrum to its highest valued uses. The central regulatory failure is that it is beyond any regulator's capacity to acquire and process all of the information needed to efficiently repurpose the C-Band spectrum in

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16 C Band Alliance, "CBA 300 MHz Ex Parte," p. 2, Oct. 28, 2019; *See also*, ("CBA Technical Ex Parte Oct. 31, 2019")., Oct. 31, 2019.,

17 C Band Alliance, "Revised Transition Implementation Process," GN Docket No. 18-122, November 8, 2018, https://ecfsapi.fcc.gov/file/11081123220243/CBA%20-%20Updated%20Transition%20Implementation%20Process.pdf.

18 Comments of the C-Band Alliance on the "July 19 Public Notice," pp. 4, 26-27, GN Docket Nos. 17-183, 18-122, August 7, 2019, https://ecfsapi.fcc.gov/file/108071378423084/CBA%20-%20Comments%20to%20Other%20Proposals%20PN.pdf, ("CBA August 7 Comments").

19 Coleman Bazelon, "Maximizing the Value of the C-Band." *See also*, FCC, "C-Band Order and NPRM"; "CBA Oct. 29, 2018 Comments on C-Band Order and NPRM," p. 2.

a timely manner. These market and regulatory failures impede industry and regulators as they try to find the optimal transition mechanism and amount of C-Band spectrum to repurpose for terrestrial 5G uses.[20]

To clear socially optimal amounts of spectrum, an omniscient regulator would clear spectrum until the social cost of clearing one more megahertz of spectrum would just equal the benefit from repurposing that megahertz. The CBA proposal replicates this outcome because only the CBA members have the unique mix of information about the band needed to determine the social equilibrium. The other proposals in the C-Band proceeding cannot reach this optimal outcome because distortions generated by information asymmetries and market failures cause marginal private costs and benefits to diverge from marginal social costs and benefits. That is, the decisions made by private actors will not lead to the social optimum. By correcting the C-Band market failures, the CBA proposal incentivizes the transition facilitator (i.e. the CBA) to internalize the information inside the boundaries of the consortium that lead their private choices to align with the social optimum. That is, the CBA's incentives will be to repurpose spectrum up to the point where marginal social benefit equals marginal social costs, thereby maximizing social welfare. Such a Pareto-improving solution would be difficult to achieve under other proposals.

As discussed earlier in this paper, the amount of spectrum offered for repurposing has increased in line with the market signals about the increased demand for this mid-band spectrum for 5G, and with input from various stakeholders. Combining the best of a market-based solution and a managed transition that minimizes service disruption, the CBA proposal offers an efficient mechanism to make C-band spectrum available for terrestrial 5G use. The true public interest benefits of the CBA proposal, however, go well beyond any specifics of amounts and timing of reallocations. The proposal directly addresses the underlying market failures and puts in place the incentives for all stakeholders to discover the optimal solution to repurpose C-Band spectrum. The information gained throughout the process has informed the CBA and enabled it to make dynamically efficient decisions, such as how much spectrum to make available, when this spectrum should be made available, and how the initial investments to make spectrum available will interact with later, longer-term efforts to repurpose spectrum.

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[20] FCC, "C-Band Order and NPRM," ¶ 59.

A. The CBA Proposal Solves the Holdout Problem

The CBA, acting as the Transition Facilitator, can solve the holdout problem that results from overlapping rights.[21] Nonexclusive access to spectrum is a market failure that violates the 1st Welfare theorem – that a well working market maximizes welfare.[22] Consequently, private transactions without a Transition Facilitator will not maximize economic efficiency. As discussed in my October 2018 analysis, by creating a Transition Facilitator and imposing clearly defined limits on providers that are not part of the Transition Facilitator, the nonexclusive rights are brought under common consideration. Ronald Coase's 1937 paper, "The Nature of the Firm," discussed how firms' boundaries are determined by minimizing transactions costs.[23] If an activity is less costly to execute within a firm than through a market transaction, then value is increased if that activity is done within the firm. As Coase also pointed out, market forces will often lead firms to organize themselves to internalize such transaction costs to achieve more efficient outcomes.[24] The CBA Members are doing precisely that. The CBA is a mechanism that solves the "failure" created by the nonexclusive rights to use the C-Band. Through the voluntary formation of the consortium proposed by the CBA, the holdout problem is solved, as recalcitrant or uncooperative satellite providers will not benefit as much as cooperative ones. This brings the satellite operators under one "firm," thereby creating an integrated entity with the ability and incentives to maximize efficiency and value creation for itself, and as a side benefit maximize efficiency and value creation for society.[25]

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21 Overlapping rights in the C-Band were an efficient solution to facilitate use of the band for satellite-based services. The holdout problem only emerges in the context of trying to repurpose portions of the band for terrestrial use. *See* Coleman Bazelon, "Maximizing the Value of the C-Band," pp. 8 – 11.

22 Mas-Colell, Whinston and Green, Chapter 16, in *Microeconomic Theory*, (Oxford, England: Oxford University Press, 1995), , https://claseseconomia2015.files.wordpress.com/2016/03/microeconomictheory.pdf.

23 Ronald H. Coase, "The Nature of the Firm," *Economica*, Vol. 4 (16), pp. 386-405, November 1937.

24 Ronald H. Coase, "The Nature of the Firm," *Economica*, 4 (16), pp. 386–405. 1937.

25 Coleman Bazelon, "Maximizing the Value of the C-Band," pp. 24. *See also*, Holman W. Jenkins Jr., "How the Government Can get Brave about Spectrum," June 14, 2019, *The Wall Street Journal*, accessed October 11, 2019, https://www.wsj.com/articles/how-government-can-get-brave-about-spectrum-11560552078; T. Randolph Beard, George S. Ford and Michael Stern, "Innovation in Spectrum repurposing: The C-Band as a Principal-Agent Problem," Phoenix Center Policy Bulletin No. 47, September 2019, https://www.phoenix-center.org/PolicyBulletin/PCPB47Final.pdf.

This approach works even without Eutelsat in the CBA, given its relatively small market share.[26] Eutelsat's revenues represent less than 5% of revenues created from C-band based services.[27] From outside the CBA, Eutelsat and its customers can readily be made whole, with any transition costs covered by the CBA. In fact, the CBA has publicly stated that all eligible satellite operators can opt to become a part of the CBA, and it has also committed to reimbursing reasonable transition costs for all earth stations, even those not registered with the FCC.[28] By not cooperating with the CBA to maximize value creation, Eutelsat will not be rewarded by sharing the gains earned by the CBA for conceptualizing and implementing the value creating transition. If Eutelsat rejoins CBA, it will share in the net proceeds in a non-discriminatory way.[29] As a factual matter, Eutelsat is unlikely to be a holdout.[30] Eutelsat has stated that it "continues to support the CBA's proposal of employing a secondary markets approach to rapidly clear a significant portion of the 3.7-4.2 GHz band for 5G wireless services,"[31] In that regard, the CBA has proposed as part of its internal governance to share any value created based on the share of revenues generated by FSS operators for services using C-Band frequencies delivered to customers located in the continental United States.[32] This is a sensible approach, supported by the underlying economics of the CBA's activities. Any revenue

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26 Bevin Fletcher, "Eutelsat CBA Exit Won't Impact C-band Proposal, Remaining Members Say," *Fierce Wireless*, September 4, 2019, accessed September 15, 2019, https://www.fiercewireless.com/regulatory/eutelstat-cba-exit-won-t-impact-c-band-proposal-remaining-members-say.

27 Recently, Eutelsat announced it is withdrawing from the C-Band Alliance. The three remaining members, Intelsat, SES and Telesat, account for 95% of the U.S. C-Band revenues, and hence the departure of Eutelsat will not hinder the Alliance's ability to efficiently repurpose the C-Band spectrum. CBA, "C-Band Alliance Issues Response to Eutelsat Decision to Withdraw from Alliance," September 3, 2019, Accessed September 4, 2019, https://c-bandalliance.com/wp-content/uploads/2019/09/FINALC-Band-Alliance-Response-Statement.pdf.

28 CBA Ex Parte on the "C-Band Order and NPRM," p. 1, GN Docket No. 18-122, September 24, 2019, https://ecfsapi.fcc.gov/file/1092429169928/CBA%20-%20Ex%20Parte%20re%209-20-19%20OGC%20Meeting.pdf, ("CBA ExParte on C-Band Order and NPRM").

29 CBA, "CBA Ex Parte on the C-Band Order and NPRM," p. 1.

30 Eutelsat Ex Parte Communication, GN Docket No. 18-122, November 7, 2019, https://ecfsapi.fcc.gov/file/1108297359740/Eutelsat%20Ex%20Parte%20Notice%20(FINAL%202019-11-07).pdf.

31 Ex Parte Letter from Bruce A. Olcott, Counsel to Eutelsat S.A., to Marlene H. Dortch, Secretary, FCC, GN Docket No. 18-122 (filed Sept. 19, 2019).

32 "CBA Oct. 29, 2018 Comments on C-Band Order and NPRM," p. 55, ("compensation to C-Band Alliance members will be based on their recent, already determinable, CONUS C-band revenues").

raised by the CBA from C-Band spectrum sold to terrestrial wireless operators will first be used to pay for the transition costs that are required to free up the spectrum. Whether CBA member or not, or customer of CBA member or not, all current users' costs from the transition will be reimbursed.[33] Any revenue retained by the CBA above and beyond these costs and any potential voluntary contribution to the Treasury will be distributed to its members as compensation for the efforts to conceive and implement the transition.

Any excess revenue should be returned to its members in proportion to their contribution to the creation of value. The economic value contribution of CBA members is the pre-transition opportunity cost of the spectrum resource deployed by those members. That opportunity cost is the economic value, more commonly known as profits, created by pre-transition uses of the C-Band spectrum.

The satellite industry has several features that make measuring profits created from C-Band services challenging. First, satellite services are characterized by large fixed and sunk investments accompanied by relatively smaller incremental margins. This means any gross margin calculation will not account for significant capital expenditures and any net income calculation that does account for depreciation and amortization of fixed assets is subject to somewhat arbitrary accounting procedures. Second, the capital accounting requirements are further complicated by the multi-band structure of most modern satellites. That is, the fixed costs of a satellite that serves the C-Band is shared in part by transponders for non-C-Band services, such as the Ku band. Consequently, the proportion of any satellite serving the C-Band impacts the costs allocated to the C-band, yet that allocation is determined by the design characteristics of the satellite. Additionally, not all satellites serve the full continental United States at sufficient power to provide value-creating commercial service. For instance, while Hipasat covers most of the United States and Arsat covers most of Florida, the power levels are such that it hinders service provision.[34] Others, such as ABS and StarOne do not serve the United States in any meaningful manner.[35] This further

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33 CBA, "Customer Commitment Ex Parte," April 3, 2019.

34 The coverage maps for Hipasat and Arsat with the power level are from their website and from the FCC respectively, https://www.hispasat.com/contenidos/web/0/194-h30w-6-2.pdf, *See also*, Empresa Argentina de Soluciones Satelitales S.A., "To Add ARSAT-2 to the Permitted Space Station List," Petition for Declaratory Ruling, https://www.hispasat.com/contenidos/web/0/194-h30w-6-2.pdf.

35 The coverage maps with the power level are from their websites, http://www.absatellite.com/satellite-fleet/abs-6/, http://www.absatellite.com/satellite-fleet/abs-3a/, http://www.starone.com.br/en/internas/satelite_c1/, http://sky-brokers.com/uploads/a0/dc/a0dca599b10680904490110238d68721/ARSat-2-Satellite-Footprint.pdf.

complicates calculating the value contribution to the U.S. by these carriers. The result of these factors is that allocating value by member profits would be difficult. And unnecessary. Domestic service revenues, however, are likely highly correlated with profits and much more straightforward to measure.

B. Optimizes the Amount and Timing of Spectrum Reallocated

The CBA proposal most efficiently optimizes the amount and timing of spectrum made available to the market. It has committed to clearing a total of 300 megahertz of spectrum (280 megahertz and a 20 megahertz guard band), with 100 megahertz of spectrum becoming available within 18 months in 46 of the top 50 PEAs from the date of an FCC Order.[36] The entire 280 megahertz of spectrum will be available throughout the continental US within 36 months from a CBA-led auction.[37]

The CBA members uniquely understand the C-Band ecosystem, which allows it to achieve the threefold objective of 1) maximizing the amount of spectrum to be repurposed, 2) protecting incumbents by finding and implementing the least costly, least disruptive solution for clearing the band, and 3) minimizing the time to market for the cleared spectrum.[38]

First, the CBA, as the Transition Facilitator, and its customers have all of the incentives in place to create value by repurposing additional frequencies when the benefits outweigh the costs. One concern expressed is that if the CBA had market power as a consortium, it would restrict spectrum supply, or would delay the transition to extract extra rents. However, the CBA does not have market power as the supply of spectrum is not just the C-Band, and the market for spectrum is not

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36 C Band Alliance, "CBA 300 MHz Ex Parte," p. 1.

37 C Band Alliance, "CBA 300 MHz Ex Parte," p. 1.

38 "CBA Oct. 29, 2018 Comments on C-Band Order and NPRM," p. 9. *See also*, FCC, "C-Band Order and NPRM," ¶27-29, https://docs.fcc.gov/public/attachments/FCC-18-91A1_Rcd.pdf; C-Band Alliance, "Customer Commitment Ex Parte," GN Docket No. 18-122, filed April 3, 2019, https://ecfsapi.fcc.gov/file/10403446622844/CBA%20-%20Customer%20Commitment%20Ex%20Parte%20-%204-3-19.pdf. ("Customer Commitment Ex Parte").

inelastic enough to make such a strategy profitable.[39] If it attempted to restrict the amount of spectrum made available and raise prices, the price increase would not compensate for the reduced quantity of spectrum sold.[40] Additionally, the CBA, as the Transition Facilitator, has an added incentive not to undersupply the market for terrestrial spectrum because doing so may create market dynamics that create market power for the purchasers of the repurposed spectrum.[41]

Another, and countervailing, concern raised is that satellite operators will not repurpose the socially optimal amount of spectrum because with excess capacity eliminated through repurposing, the higher prices they will obtain from video delivery will skew incentives. [42] This is unlikely. We understand that at least one FSS satellite company has given its customers price commitments, thus setting the market and limiting the ability of the other companies to raise service prices. Furthermore, the value of C-Band in terrestrial mobile uses significantly exceeds the value of many C-Band based satellite services so any modest increases in the prices paid for satellite video services

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[39] If the CBA chose to make 300 megahertz available instead of 400 megahertz, a plausible increase in price would be around 11%. But to achieve this price increase in this example, it would have to withhold one-fourth of the supply (¼ = 100 megahertz/400 megahertz), forgoing a similar share of revenue Assuming a price elasticity of -1 and a spectrum inventory of 900 megahertz (low and mid-band spectrum), we can compute the decrease in price that would occur if 400 megahertz and 300 megahertz of spectrum was supplied by the CBA. If 400 megahertz is offered, it would imply a 44% increase in quantity (calculation: 44% = 400 megahertz/ 900 megahertz) and consequently a 44% decrease in price. If 300 megahertz is offered, it would imply a 33% increase in quantity (calculation: 33% = 300 megahertz/ 900 megahertz) and a 33% decrease in price. Thus, withholding 100 megahertz, i.e. 11% of the quantity, would imply a price that would be 11% higher than if 400 megahertz of spectrum was offered. Coleman Bazelon, "Maximizing the Value of the C Band," p. 37-38. *See also* Reply Declaration of Jeffrey A. Eisenach on the ""C-Band Order and NPRM," pp. 4, 17, GN Docket No. 18-122, December, 2018, https://ecfsapi.fcc.gov/file/1207392316779/Eisenach%20Declaration%20for%20Reply%20Comments%20of%20the%20C-Band%20Alliance.pdf.

[40] Coleman Bazelon, "Maximizing the Value of the C-Band," p. 38.

[41] If the supply is too small, a market division strategy by the two largest bidders would be plausible and reduce demand from other bidders, leading to lower prices. As noted in the Auctionomics white paper, other mechanisms such as multi-round non-combinatorial auctions may suffer from collusive behavior and market splitting, which this current format does not. *See* Auctionomics, "FUEL for 5G: Flexible Use and Efficient Licensing," White Paper Filed as C-Band Alliance Ex Parte, June 12, 2019, https://ecfsapi.fcc.gov/file/1061231991411/CBA%20-%20Auctionomics%20white%20p|aper%20ex%20parte%206.12.2019.pdf.

[42] ACA – America's Communication Association, "C-Band Order and NPRM Ex Parte Letter," pp. 3, GN Docket No. 18-122, March 25, 2019, https://ecfsapi.fcc.gov/file/1032583062787/(as%20filed)%20ACA%20Ex%20Parte%2025Mar2019.pdf.

are unlikely to alter the choices made by satellite operators when they evaluate the costs and benefits of repurposing spectrum.[43]

Second, the CBA has committed to protecting its customers from the adverse effects of relocation.[44] The satellite providers will be paying for new equipment in cases where customers and end-users require them. To this end, the CBA has earmarked "120% of the estimated spectrum clearing costs" and will be using it to pay for the cost of clearing the spectrum, all costs associated with repacking satellite services and expenses incurred by customers and end-users.[45] This CBA action is a clear commitment to ensure that customers are not any worse off after the relocation of a portion of the C-band spectrum.[46] And since the CBA benefits from any efficiencies in protecting incumbents, they are well-incentivized to find the most efficient transition approach. Assuring no stakeholder is worse off is an important foundation for creating efficient and welfare-enhancing voluntary repurposing of the C-Band.[47] With this foundation, further efficiency gains are more easily facilitated. For example, if economically advantageous, additional spectrum may be repurposed by some customers relinquishing use of C-Band services if the additional frequencies made available are more valuable to terrestrial operators.

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43 Coleman Bazelon, "Maximizing the Value of the C-Band," p. 23.

44 Intelsat Corporation, SES Americom Inc., Intel Corporation and C-Band Alliance, Notice of Ex Parte, GN Docket No 18-122, October 9, 2018, https://ecfsapi.fcc.gov/file/100908982048/As%20Filed%20-%2010-09-18-Ex%20Parte%20-%20Intelsat%2C%20SES%2C%20Intel%2C%20C-Band%20Alliance.pdf.

45 C Band Alliance, "Customer Commitment Ex Parte," p. 8, April 3, 2019.

46 This commitment provides the foundation to ensure that any repurposing of C-Band spectrum is truly Pareto improving, meaning a change in the use of the band that makes some participants better off and none worse off.

47 As promised in the Customer Commitment Ex Parte, the customers, such as various radio stations, will not be any worse off under this proposal as the CBA will reimburse all transition cost and has committed to launching new satellites to ensure sufficient capacity. *See also* C-Band Alliance, "Customer Commitment Ex Parte," pp. 8; Ex Parte Letters from Amb-OS, April 30, 2019; INSP, April 24, 2019, https://ecfsapi.fcc.gov/file/10429141106282/ExParteSupport_CBA.pdf ; The Spaceconnection Inc., April 1, 2019, https://ecfsapi.fcc.gov/file/10401252681536/The%20SPACECONNECTION%20-%20Supprt%20Letter%20CBA%20-FCC.pdf). The smaller satellite operators, will also be no worse off, as demonstrated by their support for the CBA proposal over other proposals (Olympusat, "C-Band Order and NPRM," Ex Parte Letter, GN Docket No. 18-122, August 13, 2019, https://ecfsapi.fcc.gov/file/10814796519041/Olympusat%20Letter%20to%20FCC%208-13-19.pdf).

Third, the current FCC approach to clearing spectrum in a band with incumbent users, even without the problems created by nonexclusive spectrum rights, by using a reverse and forward auction, as in the case of the Broadcast Incentive Auction, takes significant time.[48] Such an approach would also be very risky. Two satellite operators—Intelsat and SES—account for 90-95% of the C-Band revenues in the U.S.[49] Consequently, designing an efficient reverse auction would be difficult and non-participation by either operator would sink the auction. By bringing these operators into common interest, the proposed CBA mechanism will resolve any uncertainty or ambiguity of rights – a prerequisite to any auction process. Equally importantly, the process can be fairly long and drawn-out with significant government involvement and cost.[50] Recognizing this experience, Chairman Pai recently said in an Open FCC meeting that an incentive auction

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[48] Thomas K. Sawanobori and Robert Roche, "From Proposal to Deployment: The History of Spectrum Allocation Timelines," CTIA, 2015, https://api.ctia.org/docs/default-source/default-document-library/072015-spectrum-timelines-white-paper.pdf.

[49] Kerrisdale Capital, "Intelsat S.A. and SES S.A. – To The Moon," p. 28, June 2018, https://www.kerrisdalecap.com/wp-content/uploads/2018/06/Intelsat-and-SES.pdf.

[50] Early in the process that led to the Broadcast Incentive Auction, I testified before the U.S. House of Representatives, Committee on Energy and Commerce, Subcommittee on Communication and Technology on April 12, 2011 about the merits of a broadcast incentive auction. The final 600 MHz spectrum will be cleared by 2020, 9 years later. *See* "Oral Testimony of Coleman Bazelon, The Brattle Group, Inc.," U.S. House of Representatives, Committee on Energy and Commerce Subcommittee on Communication and Technology, April 12, 2011, https://brattlefiles.blob.core.windows.net/system/news/pdfs/000/000/231/original/oral_testimony_of_coleman_bazelon_apr_12_2011.pdf?1377791292. *See also* Paul Weiss, "FCC Allocates Initial $12 Billion for Post Incentive Auction Repacking as House Members Urge FCC To Adhere to Repacking Deadline," October 20, 2017, Accessed April 16, 2019, https://www.lexology.com/library/detail.aspx?g=eb83d9e6-d43c-420b-9651-dcfe2f197346; FCC, "Broadcast Incentive Auction and Post-Auction Transition," Accessed September 4, 2019, https://www.fcc.gov/about-fcc/fcc-initiatives/incentive-auctions; Technology Policy Institute, "Don't Be Disappointed by the FCC's Incentive Auction," January 17, 2017, Accessed April 16, 2019, https://techpolicyinstitute.org/2017/01/17/the-fccs-incentive-auction-is-not-a-disappointment/; R Street Institute Ex Parte Letter on the "C-Band Order and NPRM," April 30, 2019, https://ecfsapi.fcc.gov/file/1043017958806/3.7-4.2%20exparte%203.pdf; Randolph J. May and Gregory J. Vogt, "A Free Market Approach Should Be Used to Reallocate C-Band Spectrum," Perspectives from FSF Scholars, p. 4, Vol 14 (17), The Free State Foundation, July 17, 2019, accessed October 10, 2019, https://freestatefoundation.org//wp-content/uploads/2019/08/A-Free-Market-Approach-Should-Be-Used-to-Reallocate-C-Band-Spectrum-071719.pdf. *See also*, Will Rinehart, "Analyzing Plans to Reallocate C-Band for 5G Deployment," Insight, p. 4, American Action Forum, October 7, 2019, accessed October 11, 2019, https://www.americanactionforum.org/insight/analyzing-plans-to-reallocate-c-band-for-5g-deployment/.

would delay the availability of mid-band spectrum.[51] The CBA proposal brings this spectrum to market significantly more quickly than other proposals, and given the imperative of building a 5G ecosystem, a faster availability is important.[52]

III. A New Policy Tool for Maximizing Spectrum Value

The CBA's market-based mechanism is an evolution of the auction mechanisms that the FCC has used to assign spectrum for more than two decades. This mechanism can be applied to other spectrum bands to spur spectrum availability without lengthy government intervention, and can serve as a model for reallocation in other bands. In the C-Band, the nonexclusive rights imply that there may be a holdout problem when repurposing this band. Other bands may also suffer from a similar holdout problem that inhibits socially beneficial repurposing of spectrum.

While the FCC has unparalleled expertise in conducting complex auctions, including reverse and incentive auctions, it has not addressed situations where property rights were not well-defined.[53] In fact, an auction without well-defined property rights would be impossible. Consequently, resolving the overlapping property rights problem is a prerequisite to any efficient solution. Working through these issues in a regulatory context will involve significant time and cost. In

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51 Statement of Chairman Ajit Pai, "Transforming the 2.5 GHz Band," p. 2, WT Docket No. 18-120, Adopted July 10, 2019, https://www.fcc.gov/document/fcc-transforms-25-ghz-band-5g-services-0/pai-statement.

52 Daniel Lyons, "Secondary Markets Can Pave the Way for Rapid 5G Deployment," AEIdeas, American Enterprise Institute, March 21, 2019, accessed October 11, 2019, https://www.aei.org/technology-and-innovation/telecommunications/secondary-markets-can-pave-the-way-for-rapid-5g-deployment/. *See also*, Roslyn Layton, "Mid Band Spectrum Is the Next Critical Piece to Timely 5G Deployment," *Forbes*, May 1, 2019, accessed October 11, 2019, https://www.forbes.com/sites/roslynlayton/2019/05/01/mid-band-spectrum-is-the-next-critical-piece-to-timely-5g-deployment/#76ba1f851922.

53 The 600 MHz Broadcast Incentive Auction involved a complex reverse and forward auction. A successful reverse auction was possible in that case because the property rights of broadcasters were well defined. See Paul Milgrom and Ilya Segal, "Designing the US Incentive Auction," 2013, https://milgrom.people.stanford.edu/sites/g/files/sbiybj4391/f/designing_the_us_incentive_auction_handbook_milgrom-segal_final.pdf.

general, the FCC has used some variant of the sequential multiple round ascending auction to make spectrum available in bands where there are no incumbents. This is done in instances where the Commission can definitively determine how much spectrum to offer in the auction, the terms of deployment, and effort to make the spectrum available is separate from licensing by auction. However, in bands where it is unclear how many incumbent users to transition, such as in the 600 MHz television broadcast band, the FCC has employed a two-stage auction (a reverse and forward auction) to let the market determine spectrum supply and demand.[54] The CBA's market-based approach is an evolution of the auction-based approach that the Commission has adopted for efficient spectrum assignment. In bands with incumbent users and nonexclusive rights, it provides a path forward to encourage incumbents to engage in socially beneficial repurposing of their spectrum. As the current analysis shows, for the C-Band this approach is voluntary, fast, efficient, and protects incumbents, end-users, and consumers. The same may be true for other bands that also have similar market and regulatory failures.

The CBA proposal is a potential market-based solution that not only solves the current C-Band problem, but also shows a path forward for bringing more spectrum online to meet 5G or any future needs under circumstances where spectrum rights are not clearly defined and fully separable. The adoption of this policy for the C-Band signals the Commission's support for all incumbent spectrum users to examine their uses and propose efficiency enhancing reallocations that only they will have the knowledge to develop and implement.

That the current discussion about the C-Band is focused on how much to repurpose and how soon, is already a victory for this new policy approach. If the CBA members had not come forward with their proposal, it is highly likely that a protracted FCC proceeding would be ongoing for years to come. As previously noted, such a proceeding would have been hindered from the outset by a lack of reliable information needed to inform the FCC's reallocation decision. Instead, through the CBA consortium market-based approach, we know that 300 megahertz can be repurposed within 18-36 months and that the right incentives are in place so that additional spectrum may become available after that initial time period, without an overly involved FCC proceeding. If the CBA approach is successfully implemented in the C-Band, the Commission will be able to use this novel approach

[54] FCC, "Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions," Report and Order, GN Docket No. 12-268, Adopted May 15, 2014, https://docs.fcc.gov/public/attachments/FCC-14-50A1.pdf.

to incentivize incumbents to offer valuable spectrum in other bands that also suffer from market and regulatory failures.

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